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(54) HEAT AVERAGING THERMALLY RESPONSIVE DEVICE

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ABSTRACT

A thermal activated device having a thermally responsive sensor for switching from one impedance state to another in the presence of heat and a long averaging thermal conductor for sensing and averaging the heat and for conducting the averaged heat to the thermally responsive sensor.

HEAT AVERAGING THERMALLY RESPONSIVE DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to a heat averaging thermally responsive device and, more particularly, to a thermally responsive device having a long averaging thermal conductor for sensing and averaging heat and for conducting the averaged heat to a thermally responsive sensor.

Although the present invention may have many varied uses, it is particularly useful in acting as a limit control for electric baseboard heaters. Electric baseboard heaters are typically elongated resistance type heaters having fins for radiating the heat generated by the current transmitted through the heater. Current is supplied to the heater in response to a thermostat which senses the temperature of the room. A typical prior art type of limit control for a baseboard heater comprises a capillary tube filled with a heat responsive fluid which, in the presence of heat, will expand. If the generated heat becomes excessive, i.e. exceeds the limit, the fluid will expand sufficiently to operate a switch. However, filled capillary tubes are expensive and require a system design which

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fails safe in the event that the capillary tube loses its fill.

Other forms of prior art limit controls which do not average heat are dependent upon the placement of the sensing element along the baseboard heater. For example, if the sensing element is located on a hot spot of the electric baseboard heater, the limit will interrupt current flow to the heater unnecessarily. On the other hand, if the limit control is placed at a cold spot on the electric baseboard heater, the limit control might not ever sense an overheating condition and fail to interrupt current flow to the electric baseboard heater when the electric baseboard heater is radiating a dangerous amount of heat.

SUMMARY OF THE INVENTION

The present invention eliminates many of these problems by providing a thermally responsive sensor for switching from one impedance state to another in the presence of heat and a long averaging thermal conductor for sensing an averaging heat and for conducting the averaged heat to the thermally responsive sensor.

Thus, the filled capillary tube is eliminated and can be replaced by a solid or non-filled conductor. The conductor averages any hot spots along the device which it is sensing.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features and advantages will become more apparent from a detailed consideration of the invention when taken in conjunction with the drawings in which:

Figure 1 shows an uncovered view of one form of the thermally responsive device;

Figure 2 shows a side view of the covered thermally responsive device of Figure 1;

Figure 3 shows the housing of the thermally responsive device of Figure 1;

Figure 4 is a cross-sectional view taken along section lines A-A of Figure 3;

Figure 5 shows the long averaging thermal conductor to be used with the device of Figure 1;

Figure 6 shows the thermally responsive device in an electric baseboard heating application;

Figure 7 shows another form of the device of Figure 1;

Figure 8 shows an alternate construction using a thermoferrite instead of a bimetal as shown in Figure 1;

Figure 9 shows a side view of the device shown in Figure 8;

Figure 10 shows the insulator used in the device of Figure 8; and,

Figure 11 (sheet 1) shows an alternate construction using a thermally responsive snap disc.

DETAILED DESCRIPTION

In Figures 1 and 2, thermally actuated device 10 is comprised of thermally responsive means or sensor 11 and a long averaging thermal conductor 12. As shown in Figure 1, sensor 11 is comprised of bimetal element 13 located within housing 14 and in thermal contact with U-shaped end 15 of conductor 12.

Conductor 12 may be of any suitable heat transmitting material such as copper for averaging heat over its length and for conducting that heat to bimetal 13. Bimetal 13 thus bends and unbends in response to changes in the heat conducted to it by conductor 12 and operates through plunger 16 against movable contact 17. Movable contact 17 is appropriately connected to terminal 18 and stationary contact 19 is appropriately connected to terminal 20.

When thermally responsive device 10 is used as a limit control in a baseboard heating application, bimetal 13 is normally bent such that plunger 16 allows contacts 17 and 19 to remain closed. As the average heat generated by the baseboard heater becomes excessive, that average heat is transmitted by conductor 12 to bimetal 13. Bimetal 13 unbends pushing plunger 16 so that contacts 17 and 19 open. Cover 21 may be

suitably attached to housing 14 and mounting screw 22 is designed for mounting the device 10 to a suitable support structure. Calibration screw 23 may be included for calibrating device 10 to respond to a predetermined limit temperature.

Figures 3 and 4 show housing 14 without the internal parts mounted therein. Housing 14 has four walls 31, 32, 33 and 34 with a floor 35. Wall 33 is T-shaped in configuration having cross pieces 36 and 37. Slot 38 in wall 34 allows terminal 18 to exit through housing 14 and slot 39 in wall 36 allows terminal 20 to exit through housing 14. Wall part 37 supports terminal 19. Part 37 also has a hole 40 for allowing mounting screw 22 to extend through housing 14.

As shown more clearly in Figure 4, floor 35 has hole 41 extending partially therethrough and a second hole 42 extending entirely therethrough. Holes 41 and 42 are adapted to mate with U-shaped end 15 of conductor 12. Conductor 12 is better shown in Figure 5. During assembly, the long leg 43 of conductor 12 is inserted from inside the housing through hole 42 such that the short leg 44 of conductor 12 is fitted into slot 41. In this manner, conductor 12 is rigidly held by housing 14 and is in such a position as to be in intimate thermal contact with bimetal 13.

X

Finally, wall 32 has a hole 46 extending therethrough for accepting calibration screw 23.

As shown in Figure 6, this device 10 can be used in a baseboard heater application. Thus, baseboard heater 50 comprises a current carrier 51 thermally contacted to a plurality of radiating fins 52. Conductor 12 of thermally responsive device 10 is stretched along baseboard heater 50 and is attached to thermal sensor 11 as shown in Figure 1. Any hot spots of baseboard heater 50 are averaged out by conductor 12 and the average heat supplied by baseboard heater 50 is transmitted to thermal sensor 11.

Figure 7 shows an alternate construction of the bimetal switch configuration. In the device of Figure 7, housing 61 has a channel 62 between walls 63 and 64 which accepts plunger 65 operating between bimetal 66 and movable contact 67.

The device in Figure 1 shows a thermally responsive sensor 11 which switches from one impedance state to another in the presence of heat as transmitted to it by conductor 12. In the case of Figure 1, the change of impedance state is the opening or closing of contacts 17 and 19.

Figures 8-10 show an alternate construction for the thermally actuated device. The thermally actuated device 100 shown in Figure 8 comprises thermal

sensor 101 and a long averaging thermal conductor 102. Thermal sensor 101 has housing 103 with a first slot 104 extending therethrough for accepting terminal 105 and a second slot 106 extending therethrough for accepting terminal 107. Terminal 107 is suitably connected to stationary contact 108 and terminal 105 is suitably connected to one end of movable contact 109 the other end of which is attached to an insulator 111 by Tinnerman clip 112. Insulator 111, shown in more detail in Figure 10, has knob 113 for receiving the Tinnerman clip 112 and smaller diameter knob 114 for accepting magnet 115. Magnet 115 is suitably attached to insulator 111.

Thermally responsive sensor 101 also has thermoferrite material 116 having a suitable Curie point such that, below the Curie point temperature, the thermoferrite is magnetic and attracts magnet 115 to it closing contacts 108 and 109. Thus, contacts 108 and 109 are in their low impedance state. As the heat conducted by averaging thermal conductor 102 increases beyond the Curie point temperature, thermoferrite 116 becomes non-magnetic and allows movable contact 109 to drop thus switching contacts 108 and 109 to their high impedance or open state.

As shown, gravity is relied upon to open contacts 108 and 109. If desired, a spring can be

added to bias contacts 108 and 109 open so that the orientation of thermal sensor 101 is not critical. Alternatively, movable contact 109 may be mounted on a leaf spring. Moreover, while it may be convenient to use a temperature responsive resistance or solid state switching device instead of contacts 108 and 109 to be responsive to the heat conducted by conductor 102, the preferred embodiment as shown in the figures is to use a mechanical switching arrangement.

Figure 9 shows a side view with cover 121 suitably affixed to housing 103 and having mounting screw 122 extending through the combination for mounting thermally responsive sensor 101.

In Figure 11, thermally actuated device 150 is comprised of thermally responsive means or sensor 151 and a long averaging thermal conductor 152. Sensor 151 is comprised of bimetal thermo snap disc 153 seated on copper heat sink washer 153 held to housing base 154 by holding screw 155. O-ring 156 fits between snap disc 153 and housing cover 157. Snap disc 153 operates against 158 to which is suitably attached movable contact 159. Movable contact 159 and stationary contact 160 have a high impedance when open but switch to a low impedance state when snap disc 153 cools sufficiently. Movable contact 159 is connected to

terminal 162. Plunger 158 may extend outside of cover 157 if manual reset is desirable.

The embodiments of the invention in which an exclusive property or right is claimed are defined as follows:

1. A thermally activated device comprising:
thermally responsive means for switching from one impedance state to another in the presence of heat; and,
a long averaging thermal conductor for sensing and averaging heat and for conducting said averaged heat to said thermally responsive means.

2. The device of claim 1 wherein said thermally responsive means comprises switching means for switching states in response to said averaged heat conducted by said long averaging thermal conductor.

3. The device of claim 2 wherein said switching means comprises a bimetal in intimate heat contact with said long averaging thermal conductor.

4. The device of claim 3 wherein said switching means comprises at least a stationary contact and a movable contact, said movable contact being moved by actuation of said bimetal in response to heat transmitted to said bimetal by said long averaging thermal conductor.

5. The device of claim 2 wherein said temperature responsive means comprises a thermoferrite material having a magnetic state dependent upon the heat transmitted by said long averaging thermal conductor.

6. The device of claim 5 wherein said switching means comprises a magnet having a position dependent upon the magnetization state of said thermoferrite.

7. The device of claim 6 wherein said switching means comprises at least a stationary contact and a movable contact, said movable contact being suitably attached to said magnet for movement therewith.

8. The device of claim 1 wherein said temperature responsive means comprises a thermoferrite material having a magnetic state dependent upon the heat transmitted by said long averaging thermal conductor.

9. The device of claim 8 wherein said switching means comprises a magnet having a position dependent upon the magnetization state of said thermoferrite.

10. The device of claim 1 wherein said thermally responsive means comprises a bimetal in intimate heat contact with said long averaging thermal conductor.

11. The device of claim 1 wherein said thermally responsive device comprises a snap disc in intimate heat contact with said long averaging conductor.

12. The device of claim 11 wherein said switching means comprises at least a stationary contact and a movable contact, said movable contact being moved by actuation of said snap disc in response to heat transmitted to said snap disc by said long averaging thermal conductor.

13. A thermally activated device comprising:

thermally responsive switching means for switching between open and closed positions in response to heat; and,

a long averaging thermal conductor for sensing and averaging heat and for conducting said averaged heat to said thermally responsive switching means.

14. The device of claim 13 wherein said thermally responsive switching means comprises a bimetal in intimate heat contact with said long averaging thermal conductor.

15. The device of claim 14 wherein said switching means comprises at least a stationary contact and a movable contact, said movable contact being moved by

actuation of said bimetal in response to heat transmitted to said bimetal by said long averaging thermal conductor.

16. The device of claim 13 wherein said thermally responsive switching means comprises a thermoferrite material having a magnetic state dependent upon the heat transmitted by said long averaging thermal conductor.

17. The device of claim 16 wherein said thermally responsive switching means comprises a magnet having a position dependent upon the magnetization state of said thermoferrite.

18. The device of claim 17 wherein said thermally responsive switching means comprises at least a stationary contact and a movable contact, said movable contact being suitably attached to said magnet for movement therewith.

19. The device of claim 13 wherein said thermally responsive device comprises a snap disc in intimate heat contact with said long averaging conductor.

20. The device of claim 19 wherein said switching means comprises at least a stationary contact and a movable contact, said movable contact being moved by

actuation of said snap disc in response to heat transmitted to said snap disc by said long averaging thermal conductor.

21. A thermally activated device responsive to the heat generated by a baseboard heater comprising:

thermally responsive means for switching from one impedance state to another in the presence of heat; and,

a long averaging thermal conductor having a length sufficient to sense and average heat generated by the baseboard heater and to conduct said averaged heat to said thermally responsive means.

22. The device of claim 21 wherein said thermally responsive means comprises switching means for switching states in response to said averaged heat conducted by said long averaging thermal conductor.

23. The device of claim 22 wherein said switching means comprises a bimetal in intimate heat contact with said long averaging thermal conductor.

24. The device of claim 23 wherein said switching means comprises at least a stationary contact and a movable contact, said movable contact being moved by actuation of said bimetal in response to heat

transmitted to said bimetal by said long averaging thermal conductor.

25. The device of claim 22 wherein said temperature responsive means comprises a thermoferrite material having a magnetic state dependent upon the heat transmitted by said long averaging thermal conductor.

26. The device of claim 25 wherein said switching means comprises a magnet having a position dependent upon the magnetization state of said thermoferrite.

27. The device of claim 26 wherein said switching means comprises at least a stationary contact and a movable contact, said movable contact being suitably attached to said magnet for movement therewith.

28. The device of claim 21 wherein said temperature responsive means comprises a thermoferrite material having a magnetic state dependent upon the heat transmitted by said long averaging thermal conductor.

29. The device of claim 28 wherein said switching means comprises a magnet having a position dependent upon the magnetization state of said thermoferrite.

30. The device of claim 21 wherein said thermally responsive means comprises a bimetal in intimate heat contact with said long averaging thermal conductor.

31. The device of claim 21 wherein said thermally responsive device comprises a snap disc in intimate heat contact with said long averaging conductor.

32. The device of claim 31 wherein said switching means comprises at least a stationary contact and a movable contact, said movable contact being moved by actuation of said bimetal in response to heat transmitted to said bimetal by said long averaging thermal conductor.

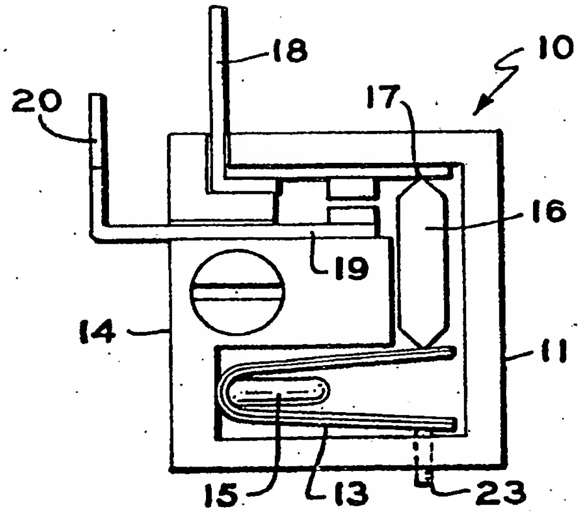

FIG. 1

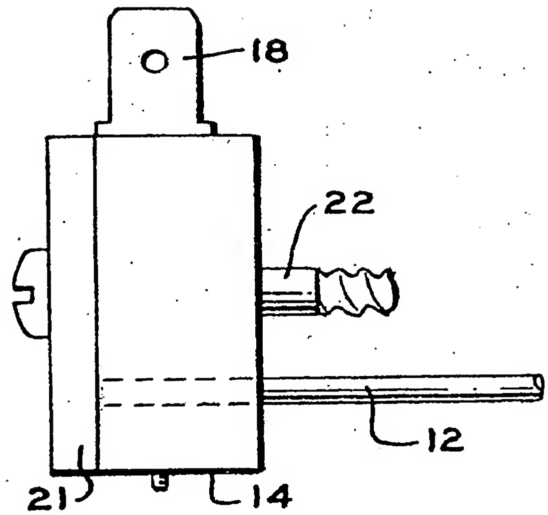

FIG. 2

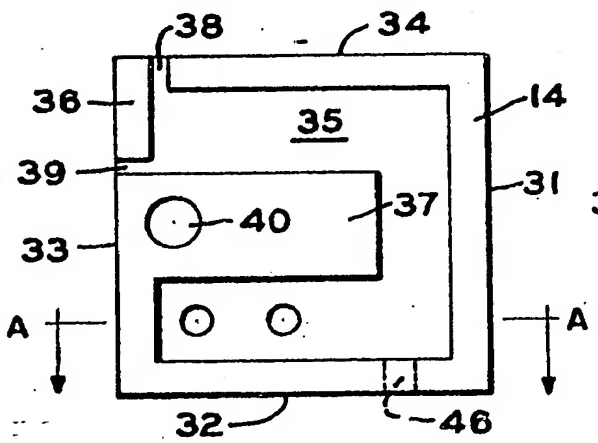

FIG. 3

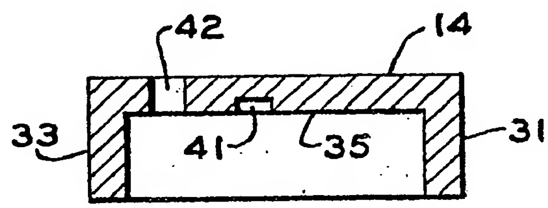

FIG. 4

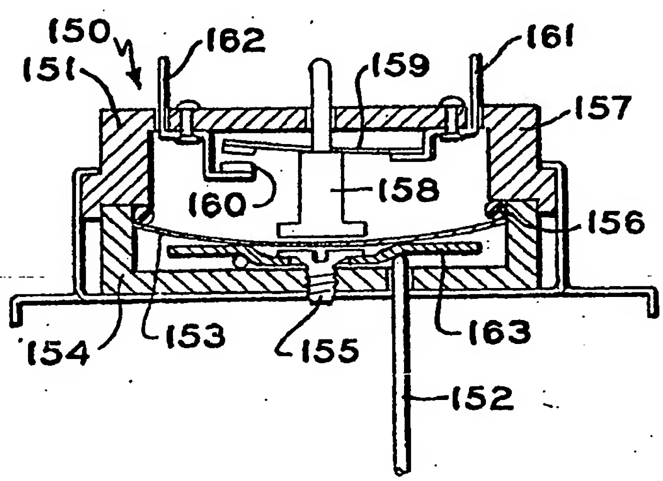

FIG. 11

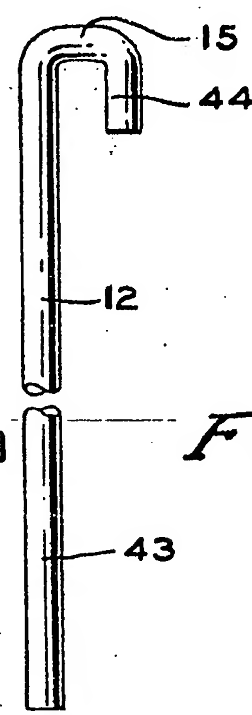

FIG. 5

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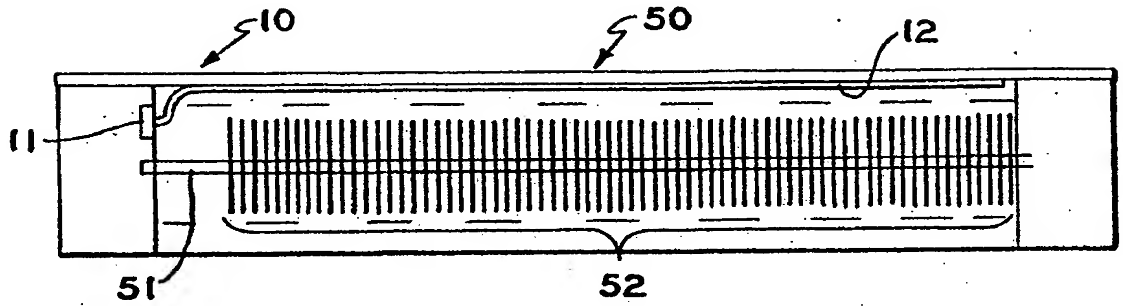

FIG. 6

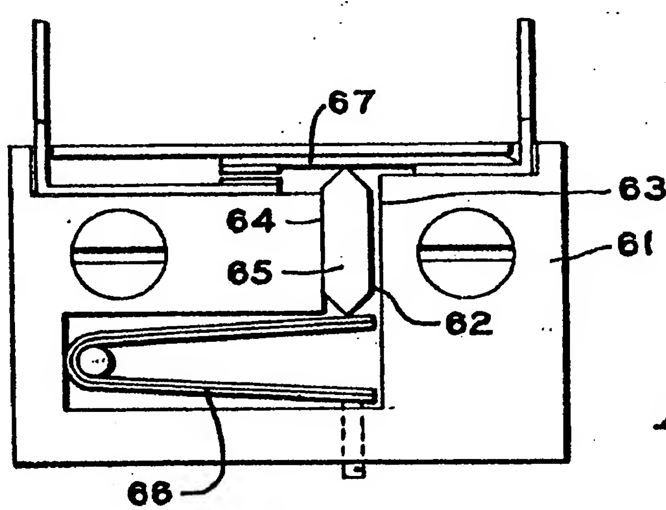

FIG. 7

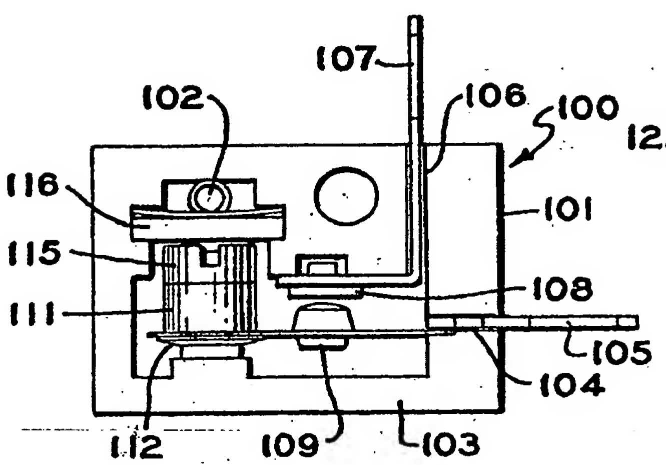

FIG. 8

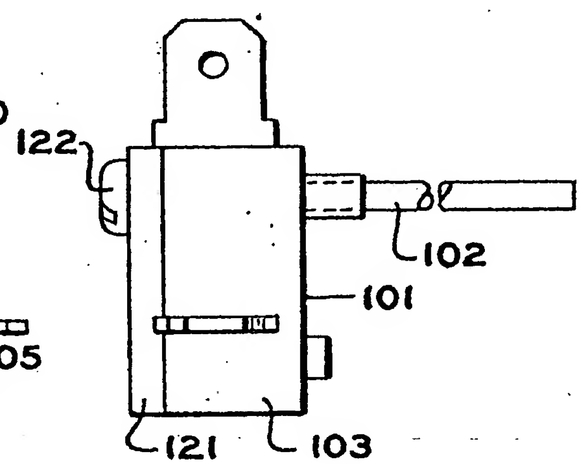

FIG. 9

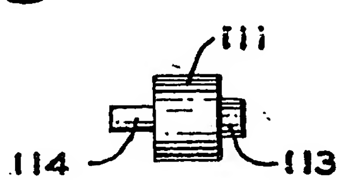

FIG. 10